Study Guide: Engineering Productivity Tips with Git, Bash and Vim

Afshine Amidi and Shervine Amidi

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Working in groups with Git

❒ **Overview** – Git is a version control system (VCS) that tracks changes of different files in a given repository. In particular, it is useful for:

- keeping track of file versions
- working in parallel thanks to the concept of branches
- backing up files to a remote server

❒ **Getting started** – The table below summarizes the commands used to start a new project, depending on whether or not the repository already exists:

Case	Action	Command	Illustration
No existing repository	Initialize repository from local folder	`git init`	
Repository already exists	Copy repository from remote to local	`git clone git_address`	

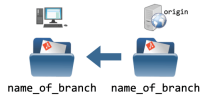
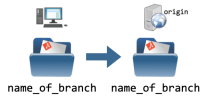
❒ **File check-in** – We can track modifications made in the repository, done by either modifying, adding or deleting a file, through the following steps:

Step	Command	Illustration
1. Add modified, new, or deleted file to staging area	`git add file`	
2. Save snapshot along with descriptive message	`git commit -m 'description'`	

Remark 1: `git add .` will have all modified files to the staging area.

Remark 2: files that we do not want to track can be listed in the `.gitignore` file.

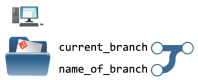
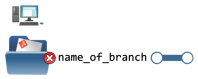
❒ **Sync with remote** – The following commands enable changes to be synchronized between remote and local machines:

Action	Command	Illustration
Fetch most recent changes from remote branch	`git pull name_of_branch`	
Push latest local changes to remote branch	`git push name_of_branch`	

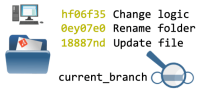
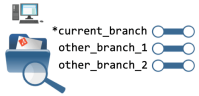
❒ **Parallel workstreams** – In order to make changes that do not interfere with the current branch, we can create another branch `name_of_branch` as follows:

Bash
```bash
git checkout -b name_of_new_branch   # Create and checkout to that branch
```

Depending on whether we want to incorporate or discard the branch, we have the following commands:

Action	Command	Illustration
Merge with initial branch	`git merge initial_branch`	
Remove branch	`git branch -D name_of_branch`	

❒ **Tracking status** – We can check previous changes made to the repository with the following commands:

Action	Command	Illustration
Check status of modified file(s)	`git status`	
View last commits	`git log --oneline`	
Compare changes made between two commits	`git diff commit_1 commit_2`	
View list of local branches	`git branch`	

❒ **Canceling changes** – Canceling changes is done differently depending on the situation that we are in. The table below sums up the most common cases:

Case	Action	Command	Illustration
Unstaged	Revert file to last commit	`git checkout -- file`	
Staged	Remove file from staging area	`git reset HEAD file`	
Committed	Go back to a previous commit	`git reset --hard prev_commit`	

❒ **Structure of folders** – It is important to keep a consistent and logical structure of the project. One example is as follows:

Terminal

```
my_project/
  analysis/
      graph/
      notebook/
  data/
      query/
      raw/
      processed/
  modeling/
      method/
      tests
  README.md
```

Working with Bash

❒ **Basic terminal commands** – The table below sums up the most useful terminal commands:

Category	Action	Command
Exploration	Display list of files (including hidden ones)	`ls (-a)`
	Show current directory	`pwd`
	Show content of file	`cat path_to_file`
	Show statistics of file (lines/words/characters)	`wc path_to_file`
File management	Make new folder	`mkdir folder_name`
	Change directory to folder	`cd path_to_folder`
	Create new empty file	`touch filename`
	Copy-paste file (folder) from origin to destination	`scp (-R) origin destination`
	Move file/folder from origin to destination	`mv origin destination`
	Remove file (folder)	`rm (-R) path`
Compression	Compress folder into file	`tar -czvf comp_folder.tar.gz folder`
	Uncompress file	`tar -xzvf comp_folder.tar.gz`
Miscellaneous	Display message	`echo "message"`
	Overwrite / append file with output	`output > file.txt` / `output >> file.txt`
	Execute `command` with elevated privileges	`sudo command`
	Connect to a remote machine	`ssh remote_machine_address`

❒ **Chaining** – It is a concept that improves readability by chaining operations with the pipe `|` operator. The most common examples are summed up in the table below:

Action	Command
Count number of files in a folder	`ls path_to_folder | wc -l`
Count number of lines in file	`cat path_to_file | wc -l`
Show last n commands executed	`history | tail -n`

❒ **Advanced search** – The `find` command allows the search of specific files and manipulate them if necessary. The general structure of the command is as follows:

```bash
find path_to_folder/. [conditions] [actions]
```

The possible conditions and actions are summarized in the table below:

Category	Action	Command
Conditions	Certain names, regex accepted	`-name 'certain_name'`
	Certain file types (`d`/`f` for directory/file)	`-type certain_type`
	Certain file sizes (`c`/`k`/`M`/`G` for B/kB/MB/GB)	`-size file_size`
	Opposite of a given condition	`-not [condition]`
Actions	Delete selected files	`-delete`
	Print selected files	`-print`

Remark: the flags above can be combined to make a multi-condition search.

❒ **Changing permissions** – The following command enables to change the permissions of a given `file` (or folder):

```bash
chmod (-R) three_digits file
```

with `three_digits` being a combination of three digits, where:

- the first digit is about the owner associated to the file
- the second digit is about the group associated to the file
- the third digit is anyone irrespective of their relation to the file

Each digit is one of (`0`, `4`, `5`, `6`, `7`), and has the following meaning:

Representation	Binary	Digit	Explanation
`---`	000	`0`	No permission
`r--`	100	`4`	Only read permission
`r-x`	101	`5`	Both read and execution permissions
`rw-`	110	`6`	Both read and write permissions
`rwx`	111	`7`	Read, write and execution permissions

For instance, giving read, write, execution permissions to everyone for a `given_file` is done by running the following command:

```bash
chmod 777 given_file
```

Remark: in order to change ownership of a file to a given user and group, we use the command `chown user:group file`.

❒ **Terminal shortcuts** – The table below summarizes the main shortcuts when working with the terminal:

Action	Command
Search previous commands	`Ctrl` + `r`
Go to beginning / end of line	`Ctrl` + `a` / `Ctrl` + `e`
Remove everything after the cursor	`Ctrl` + `k`
Clear line	`Ctrl` + `u`
Clear terminal window	`Ctrl` + `l`

Automating tasks

❒ **Create aliases** – Shortcuts can be added to the `~/.bash_profile` file by adding the following code:

```bash
shortcut="command"
```

❒ **Bash scripts** – Bash scripts are files whose file name ends with `.sh` and where the file itself is structured as follows:

```bash
#!/bin/bash

... [bash script] ...
```

❒ **Crontabs** – By letting the day of the month vary between 1-31 and the day of the week vary between 0-6 (Sunday-Saturday), a crontab is of the following format:

```terminal
  *        *        *        *        *
minute    hour     day     month     day
                 of month          of week
```

❒ **tmux** – Terminal multiplexing, often known as tmux, is a way of running tasks in the background and in parallel. The table below summarizes the main commands:

Category	Action	Command
Session management	Open a new / last existing session	`tmux` / `tmux attach`
	Leave current session	`tmux detach`
	List all open sessions	`tmux ls`
	Remove `session_name`	`tmux kill-session -t session_name`
Window management	Open / close a window	`Cmd + b + c` / `Cmd + b + x`
	Move to n^{th} window	`Ctrl + b + n`

Mastering editors

❒ **Vim** – Vim is a popular terminal editor enabling quick and easy file editing, which is particularly useful when connected to a server. The main commands to have in mind are summarized in the table below:

Category	Action	Command
File handling	Go to beginning / end of line	`0` / `$`
	Go to first / last line / i^{th} line	`gg` / `G` / `i G`
	Go to previous / next word	`b` / `w`
	Exit file with / without saving changes	`:wq` / `:q!`
Text editing	Copy line n line(s), where $n \in \mathbb{N}$	`nyy`
	Insert n line(s) previously copied	`p`
Searching	Search for expression containing name_of_pattern	`/name_of_pattern`
	Next / previous occurrence of name_of_pattern	`n` / `N`
Replacing	Replace old with new expressions with confirmation for each change	`:%s/old/new/gc`

❒ **Jupyter notebook** – Editing code in an interactive way is easily done through Jupyter notebooks. The main commands to have in mind are summarized in the table below:

Category	Action	Command
Cell transformation	Transform selected cell to text / code	Click on cell + `m` / `y`
	Delete selected cell	Click on cell + `dd`
	Add new cell below / above selected cell	Click on cell + b / a